the pathognomonic reversal of hot and cold sensation, hypersalivation, odontalgia, dysphagia, malaise, myalgias, diffuse or focal weakness, muscle fasciculations, tremor, athetosis, meningismus, ataxia, blurred vision, seizures, bradycardia, hypotension, ascending paralysis, coma and respiratory failure. Fatalities are rare. Vomiting and diarrhea resolve in from 24 to 48 hours; dysesthesias and subtle neurologic abnormalities may persist for as long as two months.

Therapy is supportive. In managing a case of acute ingestion, the use of magnesium-based cathartics should be avoided, as they may augment a calcium channel blockade. Bradyarrhythmias are responsive to administration of atropine sulfate. An intravenous infusion of calcium gluconate for hypotension has been recommended, but this treatment is as yet empirical.

The lipid-soluble component can be extracted from fish flesh with serial solvent elutions. A radioimmunoassay can detect ciguatera toxin in fish flesh, but does not identify a human syndrome. Although counterimmunoelectrophoresis of toxic (human reaction or in vivo mouse bioassay) fish extracts and human serum confirms toxic fish specimens, specimens of both immune and nonimmune human serum show precipitin reactions with toxic extracts. Therefore, it is not yet possible to conclude that affected persons have ciguatera toxin-specific antibody. Until further tests are available, the diagnosis of ciguatera toxin poisoning must be made clinically.

PAUL S. AUERBACH, MD
San Mateo, California

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The Use of Hemoperfusion to Treat Poisoning and Drug Overdose

THE GOAL in treating a case of poisoning is to limit the effects of the poison and thus prevent death or serious complications. The simplest way to prevent toxic effects is to interrupt absorption from the gastrointestinal tract with gastric-emptying procedures and adsorption with activated charcoal. Once the toxin has been absorbed into the body, its toxicity may be countered by intensive supportive care including airway protection, assisted ventilation and fluid management. These widely used treatments have reduced the mortality of poisoned patients requiring hospital care to less than 1%. More invasive and complex methods such as hemoperfusion, which increases the elimination of poisons from the system after absorption, have been widely used but poorly studied.

Hemoperfusion is done by passing a victim's blood directly over an adsorbent material (charcoal or resin) and returning the filtered blood to the patient. Standard hemodialysis roller pumps and vascular catheters are used, and the patient must be receiving heparin. Flow rates of as high as 300 ml per minute can be achieved, and when there is good extraction by the adsorbent column, significant removal is possible for some toxins. However, for a drug or poison to be effectively eliminated from the body, it must be readily accessible for such blood "cleansing"—that is, it should not be highly tissue bound or otherwise sequestered outside of the bloodstream. Thus, drugs with very large volumes of distribution, such as digoxin, tricyclic antidepressants, phenothiazines and narcotics, are unlikely to be significantly removed, whereas those with small volumes of distribution, such as theophylline, phenobarbital, salicylate and acetaminophen, are readily available for elimination.

Before undertaking hemoperfusion, one must decide whether the benefits of accelerated toxin removal outweigh the risks of vascular access and anticoagulation. For most cases of intoxication, simple supportive measures are satisfactory. Situations that might prompt the use of hemoperfusion include clinical deterioration despite maximal supportive measures; the presence of a known lethal dose or blood concentration, or the loss of normal excretory mechanisms, such as with renal or hepatic failure.

Hemoperfusion may be undertaken for phenobarbital overdose when hypotension and metabolic acidosis persist despite warming, fluids and pressors. It is indicated for theophylline intoxication when there are intractable seizures or when blood concentrations are very high (above 100 mg per liter, or 60 mg per liter in patients with chronic, accidental overmedication). It is currently recommended for cases of paraquat poisoning—even though the elimination rate is low—because of the lethality of untreated intoxication. Although hemoperfusion has been used for cases of tricyclic-antidepressant overdose, it has not been shown to remove significant amounts of the drug or its metabolites.

Although hemoperfusion is a useful method of removing some toxins, it has limited indications. Complications include vascular trauma from catheter placement, local hematomas, air embolism, intracranial bleeding and thrombocytopenia. Repeated-dose oral activated charcoal may eventually prove to be a preferable method of accelerated elimination in some patients, especially those with less severe poisoning or with contraindications to heparinization.

KENT R. OLSON, MD
San Francisco

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The Computer as Physician? Automatic External Defibrillation

RECENT EVIDENCE has suggested rather convincingly that early external defibrillation is the single most important factor in successfully reversing out-of-hospital cardiac arrest. However, many communities have neither the patient volume nor the financial resources to initiate and maintain full advanced life-support skills in their emergency medical services personnel. Basic emergency medical technicians can be trained to recognize and treat cases of ventricular fibrillation, and clinical studies have shown improvement in hospital discharge rates of around 15% for cardiac arrest victims so treated. Unfortunately, such training is not inexpensive and requires frequent refresher courses. A computerized,

self-contained device (Heart Aid, Cardiac Resuscitator Corporation, Wilsonville, Oregon) that automatically identifies ventricular fibrillation and applies countershocks is now commercially available. This automatic defibrillator requires very little training to use and costs about as much as a standard monitor-defibrillator. Electrodes are applied to the tongue and epigastrium, the machine is activated and cardiopulmonary resuscitation interrupted for a maximum of 15 seconds. The device then analyzes the electrocardiographic findings and checks for spontaneous respirations (via a breath sensor in the mouth). Countershocks are delivered when appropriate and results analyzed. Prerecorded voice messages prompt emergency medical services personnel to assist respirations, check for pulses, continue cardiopulmonary resuscitation and so forth. Rozkovec and co-workers showed the safety and efficacy of the tongue-epigastric route for cardioversion, delivering charges of up to 320 J. Jaggarao and colleagues treated 11 consecutive patients in cardiac arrest with the automatic defibrillator: six were successfully defibrillated and resuscitated and five were discharged alive from hospital. The device also has an automatic external pacing function that has not been as extensively studied. Clinical trials are ongoing in many states, and results continue to support the addition of the automatic external defibrillator as a valuable tool for emergency medical services personnel.

STEVEN M. JOYCE, MD
Tucson

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Aeromedical Emergency Care

ROTORCRAFT AEROMEDICAL emergency care was born during the closing days of World War II when the early Sikorsky helicopters were used to evacuate casualties in the European theater. The extensive use of rotorcraft for this purpose did not take place until the Korean conflict, during which time both the Army and Air Force used Bell 47s to evacuate casualties to Mobile Army Surgical Hospital (MASH) units. This expertise was extended to the civilian sector following the close of the Korean conflict in the form of dual-purpose public safety services in which rotorcraft was used for both public safety missions, such as law enforcement and fire suppression, and emergency medical service missions. Due to the dual service nature, the medical expertise of the flight crews was very limited. In the early 1970s, rotorcraft began to be based at hospitals and fully committed to emergency medical service missions. Because a rotorcraft was stationed at a hospital, the medical flight crews could be selected from the more experienced medical personnel within the institution. Flight nurses became the mainstay of these services and brought a level of medical expertise to the field heretofore unseen. At that time, paramedics could place peripheral intravenous lines, administer a limited number of drugs and use the defibrillator/cardioverter. Flight nurses, on the other hand, were trained to place endotracheal tubes, thoracostomy tubes, central intravenous lines, administer a wide spectrum of drugs and do all those procedures paramedics could do. In 1976 physicians were placed on hospital-based rotorcraft emergency care services and the potential for bringing even a higher level of expertise to the field became limited only by the training of a physician. The capability to do cricothyroidotomy, pericardiocentesis, place cranial trephines and even perform open thoracotomies in the field became a reality.

Recently, the impact of these services on mortality from blunt trauma has been investigated in two studies. In the first, the mortality of 150 consecutive trauma patients treated at the site of injury and transported to a trauma center by standard land prehospital care services was compared with that of 150 consecutive trauma patients treated at the site of injury and transported to the same trauma center by a rotorcraft aeromedical service staffed by a physician and nurse. A statistical analysis designed to predict mortality based on injury severity showed that the mortality of the land group was statistically no different from that of a large index trauma patient population treated at a major trauma center. There was a 52% reduction in predicted mortality of the aeromedical group, which was statistically significant ($P < .001$).

In the second study the same methodology was used; the mortality of 1,273 patients treated and transported by seven different hospital-based rotorcraft aeromedical services was compared with that of more than 3,000 patients treated by land emergency medical services and transported to 45 trauma centers across the United States. This study showed a 21% reduction in the predicted mortality, which was also statistically significant ($P < .001$).

In both studies the patients treated by the aeromedical services were more seriously injured than those treated by the control services. In addition, of those patients who died, death was caused by more severe injuries in the aeromedical group; of those patients who survived, survival was despite more serious injuries in the aeromedical group. The major reduction in predicted mortality was in those aeromedical patients who had suffered more severe injuries, representing less than 20% of all trauma patients treated by these services.

In conclusion, it appears that hospital-based aeromedical emergency care services may reduce mortality of at least blunt trauma patients, and that the most seriously injured patients seem to receive the greatest benefit from these services.

WILLIAM G. BAXT, MD
San Diego

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Calcium Channel Blockers in Emergency Medicine

OVER THE PAST few years a new class of drugs, the calcium channel blockers, has been introduced. As a group, these drugs inhibit the intracellular movement of extracellular calcium through voltage-dependent membrane channels. Because cardiac and vascular smooth muscle is particularly